PROJECT FACT SHEET

CONTRACT TITLE: Experimental Investigation of Relative Permeability Upscaling from the Micro-Scale to the Macro-Scale/Mega PRDA Breakout

ID NUMBER: DE-AC26-99BC15207 **B&R CODE**: AC1005000	**CONTRACTOR**: Purdue Research Foundation Sponsored Program Services **ADDR**: 1063 Hovde Hall West Lafayette, IN 47907
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PROJECT SITE **CITY**: West Lafayette **STATE**: IN **CITY**: **STATE**: **CITY**: **STATE**:	**CONTRACT PERFORMANCE PERIOD**: 8/9/1999 to 8/8/2002 **PROGRAM**: Supporting Research **RESEARCH AREA**: **PRODUCT LINE**: ADIS

FUNDING (1000'S)	DOE	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	0	0	0
FISCAL YR 1999	300	85	385
FUTURE FUNDS	726	171	897
TOTAL EST'D FUNDS	1026	256	1282

OBJECTIVE: Provide images of pores and interfacial areas in sandstone. Provide the first complete picture over such a large dynamic range.

PROJECT DESCRIPTION:

Background:

Work to be Performed: Direct experimental test of upscaling theories in fluid flow through porous media will be made by comparing measurements of relative permeability and capillary-saturation with measurements of interfacial area per volume. These experiments are performed from microns at the pore-scale to centimeters at the core-scale, spanning four orders of magnitude in size. Three objectives provide the data for rigorous experimental tests of upscaling theories: 1) Holographic laser imaging techniques will acquire pore-scale three-dimensional optical images of the pore geometry in reservoir-LIKE sandstones. This technique uses unique properties of coherent light to see through drilling muds and into the sandstone. 2) Laboratory micro-models with matched topological properties based on the data from the pore imaging will make it possible to measure interfacial area per volume in scientifically controlled imbibition and drainage experiments, combined with measurements of capillary -pressure-saturation data and relative permeability. 3) Core-scale experiments of relative permeability and capillary-saturation, and metal casts of the pore geometry, will be compared with the pore-scale data for the first two objectives. The data from all these objectives will provide the first complete picture over such a large dynamic range. It will make it possible to answer the principal question concerning flow up scaling: which microscopic measurements are most useful for producing macroscopic flow properties of an oil reservoir.

PROJECT STATUS:

Current Work: Optical Coherence Tomography: The focus of the work for the current period includes the design, fabrication, optimization, and initial testing of an optical coherence tomography system to perform laser ranging to measure surface roughness and the geometry of Wood's metal casts of pore space. This work applies to the first milestone scheduled for 18 months into the project to image to the back of the first layer of grains in the rock core using OCT.

Interfacial Area, Pore Geometry and Hydraulic Properties from Micro-Models: The work during the current period includes the design, fabrication, construction, optimization of the micro-model flow measurement system and the fabrication of controlled-idealized two-dimensional structures to test the upgraded micro-model flow measurement system. This work applies to the second milestone scheduled for 18 months into the project which includes the measurement of interfacial area, capillary pressure, saturation, absolute and relative permeability.

Wood's Metal Injection: The work during the current period includes the design, fabrication and initial testing of a special sample vessel that will be used to perform capillary pressure and relative permeability measurements using molten Wood's metal as the non-wetting phase and a second fluid to represent the wetting phase. The metal injected cores will be analyzed to determine pore space topology. This work applies to the second milestone scheduled for 18 months into the project by providing data for the fabrication of micro-models with pore topology that is statistically similar to the topology in sandstone.

Scheduled Milestones:

Optical Coherence Tomogrpahy: Image to the back of the first layer of grains in the rock core using OCT	02/01
Interfacial Area, Pore Geometry and Hydraulic Properties from Micro-Models: Measurement of interfacial area, capillary pressure, saturation, absolute and relative permeability	02/01
Wood's Metal Injection: Providing data for the fabrication of micro-models with pore topology that is statistically similar to the topology in sandstone	02/01

Accomplishments: Project has begun.